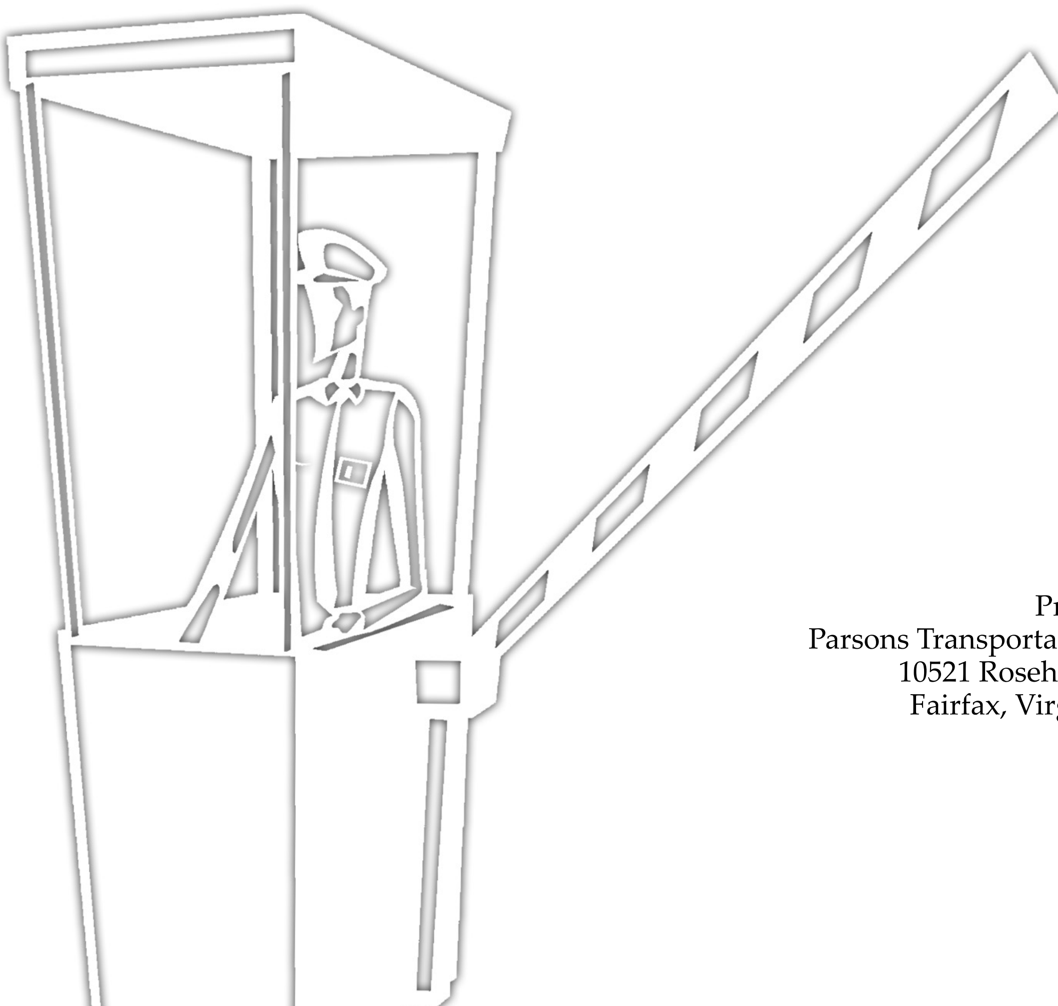
ROUTE 460 TOLL FEASIBILITY STUDY SUMMARY REPORT

State Project: 0460-969-101, P101

From: I-295 in Prince George County

To: Suffolk Bypass (Route 58) in Suffolk



Prepared by:
Parsons Transportation Group
10521 Rosehaven Street
Fairfax, Virginia 22030

April 26, 2005

1.0 INTRODUCTION AND PROJECT DESCRIPTION

Parsons Transportation Group (hereinafter 'Parsons') was tasked by the Virginia Department of Transportation (VDOT) to determine the feasibility of implementing tolls on two of the build alternatives being developed as part of the Route 460 Location Study (hereinafter 'the Location Study'). The Location Study is considering future improvements to Route 460 between Interstate 295 in Prince George County and the Suffolk Bypass (Route 58) in Suffolk. This section of the Summary Report presents the specifics of the toll alternatives considered.

1.1 TOLL ALTERNATIVES STUDIED

Prior to the commencement of this Toll Feasibility Study, the Location Study had narrowed down the build alternatives under consideration to three Candidate Build Alternatives (CBAs). Parsons was scoped to examine two alternatives for toll feasibility; given the progress made by the Location Study, Parsons recommended that these be CBAs 1 and 3. Analysis of CBA 2 was not recommended because:

- Its revenues would be significantly lower than either CBA 1 or CBA 3, because only 55 percent of its length is distinct from the present Route 460 alignment; the remaining 45 percent cannot be effectively tolled.
- For any combination of CBA 2's bypasses around towns which might be tolled, the average tolled distance per toll plaza would be less than for either CBA 1 or CBA 3. This means that the percent of gross toll revenue spent on toll collection would be higher.

Considering these factors, it is unlikely that net toll revenues from CBA 2 would amount to more than half those from CBAs 1 or 3.

Parsons assumed that access to and from both directions on intersecting roadways would be provided at each designated access point, and at their common southern/eastern terminus at the Suffolk Bypass. At the northern/western terminus, a full interchange with Interstate 295 (I-295) was assumed for CBA 1, and all movements were assumed to be possible at the intersection of CBA 3 with the existing Route 460.

CBA 1 would be a limited-access facility, following an alignment south of existing Route 460, with eight interchanges: Route 58 Bypass in Suffolk, Route 258 in Windsor, Route 616 south of Ivor, Route 620 south of Wakefield, Route 40 south of Waverly, Route 625 south of Disputanta, and I-295. A northward bend in the alternative between Waverly and Wakefield would avoid the habitat of a federally protected species.

CBA 3 would also be a limited-access facility, following an alignment north of existing Route 460, with nine interchanges: Route 58 Bypass in Suffolk, existing Route 460 near the Suffolk / Isle of Wight County border, Route 258 in Windsor, Route 616 north of Ivor, Route 31 north of Wakefield, Route 40 north of Waverly, and Route 625 north of Disputanta. It would merge with the present Route 460 south of I-295.

Both alternatives would share a new alignment east of the existing Route 460 in Windsor through to a new connection with the Route 58 Bypass in Suffolk

1.2 TOLL TECHNOLOGY AND SCHEDULES

The recent growth in toll highways in Virginia has provided an opportunity to test and refine toll operation and collection strategies, including electronic toll collection (ETC) and variable pricing. Based on the technologies and toll structures already in place, Parsons recommended closely modeling the Route 460 alternatives on the 16-mile Chesapeake Expressway (Route 168) between I-64 in Chesapeake and the North Carolina state line. Tolls would be collected at mainline toll plazas and some ramps, at which vehicles equipped with Virginia's 'Smart Tag' transponders would not be required to stop. 'Smart Tag' users would receive a discount over the cash tolls. Cash tolls would be collected at manually operated booths for other vehicles. Tolls for relatively short segments would be combined into tolls at adjacent plazas; some short trips on the alternatives would be possible without paying a toll.

Parsons recommended that three end-to-end toll rates be based on a specific rate per vehicle-mile for each vehicle class, with specific tolls rounded to the nearest 5 cents. A 'medium' toll rate of 14 cents (year 2004 dollars) per vehicle-mile would be set for two-axle vehicles; this is based on the median of selected existing Virginia toll facilities shown in **Table 1-1**. A toll of $0.07 per mile per additional axle would be charged; this pattern is similar to many other Virginia toll highways. The 'low' toll schedule would be set at one-half these rates, a level slightly higher than the lowest per-mile rate in Table 1-1. The 'high' toll structure would be set at 24 cents per two-axle vehicle-mile, based on the maximum present variable toll per minute saved on California's SR 91 (about 35 cents per minute) times an assumed time savings of 0.85 minutes per vehicle-mile (the difference between 30 mph over one mile and 65 mph over a slightly longer 1.25-mile route). Similar to the Chesapeake Expressway, toll classes would be based on the number of axles. A distinct class rate for motorcycles was set at one-half the two-axle rate.

Table 1-1. Comparison of Selected Virginia Toll Rates for Two-Axle Vehicles as of Summer 2004

Toll Facility	Length (miles)	Toll	Toll per Vehicle-Mile (cents)
Dulles Greenway (peak periods)	14.0	$2.25	16.1
Dulles Greenway (off-peak periods)	14.0	$1.85	13.2
Chesapeake Expressway	16.5	$2.00	12.1
Powhite Parkway (Richmond)	3.4	$0.50	14.7
Downtown Expressway (Richmond) I-95 to Meadow Street	2.5	$0.50	20.0
Pocahontas Parkway	8.8	$2.00	22.7
Dulles Toll Road (Route 267) I-495 to Sully Road	13.0	$0.85	6.5

Parsons recommended that 'Smart Tag' user discounts be set at 20 percent for the 'low' schedule, 15 percent for the 'medium' schedule, and 10 percent for the 'high' schedule. This will increase the fraction of drivers who choose to use 'Smart Tags', both saving motorists' time and reducing toll collection costs.

To reduce delays, toll plazas would not be provided between each pair of access points. Toll plaza locations were recommended to keep a satisfactory correlation between tolls and distance traveled. The extra highway mileage on CBA 1 to avoid wildlife habitat between Wakefield and Waverly was not counted toward the toll rate. For the 'medium' and 'high' toll schedules, plaza rates were redistributed slightly to reflect higher travel time savings expected in the southern portion of the corridor.

The recommended toll schedules (without the 'Smart Tag' discounts) are shown in **Tables 1-2a**, **1-2b**, and **1-2c**.

Table 1-2a. Assumed 'Low' Toll Schedules for Feasibility Study

Toll Plaza Location	CBA 1			CBA 3		
	Motor-cycle	Two-Axle Vehicle	Additional Axles over 2 (maximum 4)	Motor-cycle	Two-Axle Vehicle	Additional Axles over 2 (maximum 4)
South of I-295	$0.45	$0.90	$0.45	N/A	N/A	N/A
SB on ramps and NB off ramps at SR 156	$0.30	$0.60	$0.30	N/A	N/A	N/A
Between Route 156 and Disputanta	N/A	N/A	N/A	$0.45	$0.90	$0.45
North of Route 604, Wakefield	$0.55	$1.10	$0.55	$0.55	$1.10	$0.55
North of Route 258, Windsor	$0.55	$1.10	$0.55	$0.55	$1.10	$0.55
North of Route 58 Bypass, Suffolk	$0.25	$0.50	$0.50	$0.25	$0.50	$0.50

Table 1-2b. Assumed 'Medium' Toll Schedules for Feasibility Study

Toll Plaza Location	CBA 1			CBA 3		
	Motor-cycle	Two-Axle Vehicle	Additional Axles over 2 (maximum 4)	Motor-cycle	Two-Axle Vehicle	Additional Axles over 2 (maximum 4)
South of I-295	$0.75	$1.50	$0.75	N/A	N/A	N/A
SB on ramps and NB off ramps at SR 156	$0.60	$1.20	$0.60	N/A	N/A	N/A
Between Route 156 and Disputanta	N/A	N/A	N/A	$0.70	$1.40	$0.70
North of Route 604, Wakefield	$1.10	$2.20	$1.10	$1.00	$2.00	$1.00
North of Route 258, Windsor	$1.00	$2.00	$1.00	$1.10	$2.20	$1.10
North of Route 58 Bypass, Suffolk	$0.75	$1.50	$0.75	$0.80	$1.60	$0.80

Table 1-2c. Assumed 'High' Toll Schedules for Feasibility Study

Toll Plaza Location	CBA 1			CBA 3		
	Motor-cycle	Two-Axle Vehicle	Additional Axles over 2 (maximum 4)	Motor-cycle	Two-Axle Vehicle	Additional Axles over 2 (maximum 4)
South of I-295	$1.40	$2.80	$1.40	N/A	N/A	N/A
SB on ramps and NB off ramps at SR 156	$1.10	$2.20	$1.10	N/A	N/A	N/A
Between Route 156 and Disputanta	N/A	N/A	N/A	$1.40	$2.80	$1.40
North of Route 604, Wakefield	$1.90	$3.80	$1.90	$1.80	$3.60	$1.80
North of Route 258, Windsor	$1.55	$3.10	$1.55	$1.65	$3.30	$1.65
North of Route 58 Bypass, Suffolk	N/A	N/A	N/A	$0.40	$0.80	$0.40

2.0 TOLL DIVERSION ANALYSIS

The Route 460 Toll Feasibility Study considered the total projected traffic on the CBAs to be composed of six distinct travel markets, and disaggregrated three of these markets by economic characteristics to better reflect the distribution of the effects of the tolls on different segments of the driving public and commercial vehicle operators. This section of the Summary Report presents the methods used by the study, and the estimated traffic diversion from the CBAs, assuming the toll schedules presented in Section 1.

2.1 TRAFFIC ON UNTOLLED ALTERNATIVES

The basic toll diversion analysis was based on the Location Study's estimates of year 2026 average daily traffic (ADT) on each of the CBA links and along the existing Route 460. These baseline daily bi-directional volumes are shown in **Table 2-1** for each of the toll plaza locations.

Table 2-1. Baseline Year 2026 Average Daily Traffic at Proposed Toll Plaza Locations

Toll Plaza Location	CBA 1	CBA 3
South of I-295	35,800	N/A
Southbound on ramps and northbound off ramps at SR 156 (estimated)	3,500	N/A
Between Route 156 and Disputanta	N/A	30,700
North of Route 604, Wakefield	30,600	32,100
North of Route 258, Windsor	32,500	33,400
Northbound on-ramp and southbound off-ramp at Route 460	N/A	2,100
North of Route 58 Bypass, Suffolk	40,200	42,700
Total Vehicles Past Proposed Toll Locations (for comparison with toll transactions)	142,600	141,000

2.2 TRAVEL MARKET DISAGGREGATION

The travel demand model used by the Location Study separately tracked three principal types of trips: home-based work (HBW), home-based other (HBO), and non-home-based (NHB). The model also separately accounted for external-to-external (XX) and high-occupancy vehicle (HOV) trips. Parsons obtained *select link* trip data for these five categories from the estimates prepared for the Location Study by Michael Baker, Jr., Inc., *i.e.*, the pattern of trip origins and destinations that were forecast to use CBA 1 and CBA 3 without tolls. Parsons Brinckerhoff provided additional information on projected truck movements in the corridor. Parsons recombined and disaggregated these trips into income quartiles to reflect the varying response to tolls by level of income.

Trips were recombined as follows:

- All HBW and HOV trips were combined into a single 'Work-Related' (WR) travel market, on the assumption that most HOV trips were to or from work, and that the very small number of these trips (less than 2% of HBW trips) would not have a significant impact on accuracy.
- 25 percent of the XX trips were added to the WR category, based on the stated purposes of interstate trips in the 1995 *American Travel Survey* for trips among the following states and jurisdictions that would pass through Virginia: Pennsylvania, Maryland, Delaware, North Carolina, Georgia, South Carolina, and the District of Columbia. Trips between Virginia and these jurisdictions were also included.
- 30 percent of NHB trips were added to the WR category, based on a median share of NHB trips reported as work-related, from ten values from various studies, ranging from 20 to 37 percent. The underlying assumption was that these trips would be made by workers, and would have similar toll sensitivity to travel to or from work.
- All HBO trips, 14 percent of XX trips (per the *American Travel Survey*), and the non-work-related 70 percent of NHB trips were combined into a single 'Non-Work' (NW) travel market. The underlying assumption is that these additional trips would be made by non-workers, and would have similar toll sensitivity to HBO travel.
- The remaining 61 percent of XX trips (per the *American Travel Survey*) were set out as a distinct 'Leisure' (LS) travel market.

Trips were disaggregated for both the WR and NW travel markets according to Census 2000 income data by Virginia civil jurisdiction, weighted by trip rates by income quartile from a 1990 survey in the San Francisco Bay area[1]. This disaggregation is summarized in **Table 2-2**. Because of their relatively small number, leisure (LS) trips were not disaggregated.

Truck trips were disaggregated according to vehicle classification counts conducted along Route 460 as part of the Location Study, and then regrouped into axle-based categories to conform to the planned toll structure: 17 percent of the total as two-axle vehicles (travel market 2XT), 14 percent as three- and four-axle (travel market 34XT), and 69 percent as having five or more axles (travel market 5+XT). The largest group (5+XT) was divided into four quartiles according to their likely perceived value of time.

[1] *San Francisco Bay Area 1990 Regional Travel Characteristics*, Working Paper No. 4, MTC Travel Survey

Table 2-2. Basis for Disaggregation of Trips by Travel Market, Household Income Quartile, and Jurisdiction

Jurisdiction of Trip Production	Estimated Fraction of WR Vehicle Trip Productions by Income Quartile				Estimated Fraction of NW Vehicle Trip Productions by Income Quartile			
	Under $25K	$25-$49.6K	$50-74.9K	$75K & over	Under $25K	$25-$49.6K	$50-74.9K	$75K & over
Richmond	19.2%	34.2%	22.3%	24.4%	30.0%	30.2%	19.2%	20.7%
Petersburg	21.3%	37.4%	23.6%	17.7%	32.7%	32.5%	20.0%	14.8%
Hopewell	16.6%	39.9%	36.0%	7.5%	26.3%	35.8%	31.5%	6.5%
Col. Heights	8.8%	35.1%	42.4%	13.7%	14.8%	33.4%	39.3%	12.5%
Prince George	8.2%	27.2%	31.8%	32.8%	13.9%	26.2%	29.7%	30.3%
Powhatan	6.0%	25.8%	27.4%	40.8%	10.3%	25.3%	26.1%	38.3%
New Kent	6.8%	26.1%	50.2%	17.0%	11.7%	25.2%	47.3%	15.8%
Henrico	7.8%	28.6%	27.7%	35.9%	13.2%	27.5%	26.0%	33.2%
Hanover	5.5%	21.6%	28.9%	44.0%	9.5%	21.3%	27.7%	41.5%
Goochland	7.4%	21.7%	25.4%	45.6%	12.6%	21.0%	23.9%	42.4%
Dinwiddie	11.1%	32.3%	32.1%	24.4%	18.4%	30.3%	29.3%	22.0%
Chesterfield	4.9%	23.3%	29.3%	42.5%	8.5%	23.0%	28.2%	40.3%
Charles City	11.7%	30.9%	31.2%	26.1%	19.4%	28.9%	28.4%	23.4%
Southampton	17.1%	34.2%	27.9%	20.8%	27.0%	30.7%	24.3%	17.9%
Surry	14.2%	36.0%	30.3%	19.5%	23.0%	32.9%	27.0%	17.1%
Sussex	18.6%	36.5%	26.6%	18.2%	29.1%	32.4%	23.0%	15.5%
Franklin	14.6%	34.0%	27.7%	23.8%	23.5%	31.0%	24.6%	20.8%
Hampton	12.7%	34.6%	42.4%	10.4%	20.7%	32.0%	38.1%	9.2%
Norfolk	18.4%	37.7%	23.4%	20.5%	28.9%	33.4%	20.2%	17.4%
Williamsburg	15.1%	32.2%	22.2%	30.6%	24.2%	29.3%	19.7%	26.8%
V. Beach	6.9%	31.0%	30.0%	32.1%	11.8%	30.0%	28.3%	29.9%
Suffolk	12.9%	30.3%	29.2%	27.7%	21.1%	28.0%	26.3%	24.6%
Portsmouth	16.7%	37.5%	27.0%	18.8%	26.5%	33.7%	23.6%	16.3%
Poquoson	5.1%	19.7%	30.4%	44.8%	8.9%	19.4%	29.2%	42.5%
Newport News	14.3%	36.2%	27.7%	21.8%	23.1%	33.1%	24.7%	19.1%
Chesapeake	7.8%	27.4%	48.6%	16.2%	13.2%	26.3%	45.5%	15.0%
York	5.0%	24.8%	25.2%	45.0%	8.7%	24.5%	24.2%	42.6%
James City	6.8%	22.5%	25.7%	44.9%	11.8%	21.9%	24.3%	42.0%
Isle of Wight	11.0%	27.8%	29.8%	31.4%	18.2%	26.2%	27.3%	28.4%
Gloucester	9.3%	31.5%	31.5%	27.7%	15.6%	30.0%	29.1%	25.3%

2.3 TOLL DIVERSION METHODS

The fraction of traffic in each travel market estimated to divert from the Route 460 CBAs at the tolled locations was estimated using *logit* equations, which represent by a 'disutility' value the difficulty or undesirability of a particular route choice. Specifically, they assume that the market share for a route is proportional to the exponential function of the disutility.

The disutility values were estimated as linear functions of several route characteristics:

$$DU = a\,(T + 60C/V) + b\,I + c\,(60C/DV) + d\,(I/D)$$

where

T is the estimated over-the-road travel time in minutes, plus the time required to pay tolls, park, and to access and start up the vehicle before the trip;

I is the portion of T classified as 'inconvenience', *i.e.*, the time required to pay tolls, park, and to access and start up the vehicle before the trip;

C is the perceived cost of the trip in year 2004 dollars;

V is the travel market's perceived value of time, in year 2004 dollars per hour; and

D is the shortest over-the-road distance in miles between the origin and destination.

The assumed values of the coefficients *a*, *b*, *c*, and *d* are shown in **Table 2-3** for each of the travel markets. These coefficients are negative because an increase in disutility will decrease the attractiveness of a travel choice. The basic model formulation and coefficient values for two-axle vehicles were adapted from a toll diversion study Parsons conducted for the Rhode Island Turnpike and Bridge Authority[2]. The parameters for perceived cost vary slightly among travel markets because of a higher average weighted vehicle occupancy for NW and LS trips.

Table 2-3. Logit Route Choice Model Coefficients by Travel Market

Travel Markets	*a* Travel Time and perceived cost (minutes)	*b* Inconvenience (minutes)	*c* Perceived Cost per mile (equivalent minutes/mile)	*d* Inconvenience per mile (minutes/mile)
Work-Related (WR) & all Truck Markets	-0.038	-0.038	-0.0218	-0.30
Non-Work (NW)	-0.038	-0.057	-0.0175	-0.30
Leisure (LS)	-0.038	-0.057	-0.0166	-0.30

The allocation of traffic was made on the basis of 34 'superdistricts' containing one or more zones from the Location Study model. The total travel market for each CBA between each pair

[2] De Leuw, Cather & Company, *Pell Bridge Toll and Revenue Study*, for Rhode Island Turnpike and Bridge Authority, June 1998.

of superdistricts was assumed to be such that the traffic forecast by the Location Study for each link (as shown in Table 2-1) would be obtained by using this study's method. The share of the travel market allocated to the tolled routes was estimated as:

$$\text{Market Share} = \frac{\exp(DU_{tolled})}{\left(\exp(DU_{tolled}) + \exp(DU_{notoll}) + \exp(DU_{no460})\right)}$$

where

DU_{tolled} is the disutility of the tolled alternative, computed as described above;

DU_{notoll} is the disutility of the non-tolled alternative using Route 460 and/or untolled sections of the CBAs; and

DU_{no460} is the disutility of the best route not using any portion of Route 460 or the CBAs.

2.3.1 Over-the-Road Travel Time (T)

Over–the-road times for the untolled CBAs were taken from time skims of the corresponding loaded highway networks from the Location Study's traffic model. Travel times for the tolled alternatives (designated T_{tolled}) were estimated by adding inconvenience time (see subsection 2.3.2) for each toll plaza traversed.

For each origin-destination pair, a primary alternative untolled time (T_{notoll}) using 'old' Route 460 where necessary was obtained by skimming the loaded network while prohibiting the use of the tolled segments. A third travel time (T_{no460}) was estimated assuming none of Route 460 was used; for some origin-destination pairs, routes via I-64, US Route 58, or other highways would be competitive.

2.3.2 Inconvenience (I)

Because the origins and destinations of trips would be the same, the only inconvenience differential between the tolled and untolled alternatives was assumed to be the delays associated with paying the tolls. These delays were assumed to be the same at each toll plaza, and to reflect that 40 percent of all non-commercial transactions, and 70 percent of all commercial (truck) transactions would be handled by 'Smart Tags'. The basis for the assumed inconvenience times is shown in **Table 2-4**.

Table 2-4. Assumed Minutes of Inconvenience per Toll Plaza, by Travel Market

Travel Market(s)	Acceleration and Deceleration Loss (seconds)	Time in Queue (seconds)	Service & Move-up Time (seconds)	Total Inconvenience per Toll Plaza (minutes)
Two-axle (WR, NW, LS, and 2XT)	16	8	8	0.53
Three- and four-axle Truck (34XT)	28	8	9	0.75
Five-axle (or more) Truck (5+XT)	33	8	10	0.85

2.3.3 Cost (C)

For personal trips by two-axle vehicles (the WR, NW, and LS markets), the perceived cost was assumed to reflect only the direct costs for fuel, tires, and maintenance, plus one half of mileage-based depreciation, per the 2004 national averages in the 2004 version of the American Automobile Association's publication *Your Driving Costs*. For truck trips, total estimated mileage-related operating and maintenance costs, including fuel but excluding operator compensation, were used, as derived by Parsons from a synthesis of multiple sources[3,4,5,6,7,8]. These costs are shown in **Table 2-5**. For all travel markets, tolls were included in costs (C); other costs that would not differ by route or mileage, such as parking, were not included.

Table 2-5. Cost and Value Parameters (Year 2004 Dollars)

Travel Market	Perceived Cost per Vehicle-Mile	Value of Time for Quartile 1	Value of Time for Quartile 2	Value of Time for Quartile 3	Value of Time for Quartile 4
Work-Related (WR)	$0.219	$3.42	$9.64	$16.13	$35.47
Non-Work (NW)	$0.219	$1.39	$3.93	$6.57	$14.44
Leisure (LS)	$0.219	$6.96			
Two-axle truck (2XT)	$0.46	$19.50			
Three- and four-axle Truck (34XT)	$0.74	$25.00			
Five-axle (or more) Truck (5+XT)	$0.93	$7.22	$13.57	$24.44	$66.85

2.3.4 Value of Time (V)

The perceived values of time used in the estimates are shown in Table 2-5.

For the commercial 2XT and 34XT markets, the value of time was estimated as the average hourly cost of the time-dependent portion of truck maintenance costs ($1.50 and $2.50 respectively) plus an average value of driver compensation derived from the multiple sources described above for costs.

For the commercial 5+XT markets, the value of time was estimated as the estimated average hourly cost of maintaining the truck ($3.00) plus each quartile of the perceived value of time.

[3] Kawamura, Kazuya, *Commercial Vehicle Value of Time and Perceived Benefit of Congestion Pricing*, Doctoral dissertation, University of California, Berkeley) 1999
[4] US Department of Transportation, *Comprehensive Truck Size and Weight Study*, 1997
[5] US Department of Transportation, *Highway Economic Requirements System/ST User's Guide*, December 2000.
[6] Smalkoski. B. and Levinson, Dr. D., *Value of Time for Commercial Vehicle Operators in Minnesota*, University of Minnesota, December 2003.
[7] Transport Canada, *Operating Costs of Trucks in Canada – 2000* (Trimac Logistics Ltd.)
[8] US Department of Commerce, *Vehicle Inventory and Use Survey – Virginia*, April 1999.

In accordance with both established and recent research[9,10,] the determination of quartiles for the perceived value of time was based on an assumption that it was distributed lognormally, with an average value of $24.50.

The values of time for the WR and NW markets were derived from the Location Study's values for home-based work and home-based other trips, respectively. This was done both to maintain consistency with the Location Study, and because the logit model on which the estimates were based (from Rhode Island) was designed to operate using values of time corresponding to calibrated regional mode split models. The values were converted to year 2004 dollars, and based on household income data for the region, were set at 24.0, 76.6, 131.1, and 248.8 percent of the Location Study mean value.

The perceived value of time for the leisure travel market (LS) was set at $6.96, equal to the value for HBO trips (in 2004 dollars) in the Location Study. The Word Bank[11] suggests setting the leisure trip value equal to that for other non-work travel. Because of the small size and long-distance nature of this market, it was not disaggregated into quartiles.

2.4 ESTIMATED TRAFFIC AND DIVERSION AT TOLL PLAZAS

The estimated traffic for both CBA 1 and CBA 3 are shown in Tables **2-6a** through **2-6c** for the 'low', 'medium', and 'high' toll schedules respectively, by toll plaza. These tables also show the percent of the baseline traffic (from Table 2-1) diverted at these locations. On average, the 'low' toll structures diverted just over one half of the traffic which would pass the proposed toll locations without tolls; the 'medium' tolls, about 2/3; and the 'high' tolls about 4/5.

These fractions were fairly consistent between CBA 1 and CBA 3. The relatively high fraction estimated to divert is consistent with much of the baseline (no toll) traffic being attracted from routes other than the existing Route 460. CBA 3 loses slightly less traffic under the tolled alternatives because it is more distant from the existing highway.

[9] Ben-Akiva, M; Bolduc, D.; and Bradley, M., "Estimation of Travel Choice Models with Randomly Distributed Values of Time", *Transportation Research Record 1413*, Transportation Research Board, Washington, 1993: pp. 88-97.
[10] Aitchison, J. and J.A.C. Brown, *The Lognormal Distribution with Special Reference to Its Uses in Economics*, Cambridge University Press, Cambridge, 1957; pp. 107-120
[11] Gwilliam, Kenneth M., *The Value of Time in Economic Evaluation of Transport Projects: Lessons from Recent Research*, The World Bank, January 1997.

Table 2-6a. Year 2026 Average Daily Traffic and Percent Diverted, 'Low' Tolls

Toll Plaza Location	CBA 1	CBA 3
South of I-295	17,040 (52%)	N/A
Southbound on ramps and northbound off ramps at SR 156	1,790 (49%)	N/A
Between Route 156 and Disputanta	N/A	14,000 (54%)
North of Route 604, Wakefield	13,900 (55%)	15,200 (52%)
North of Route 258, Windsor	14,890 (54%)	16,000 (52%)
Northbound on-ramp and southbound off-ramp at Route 460	N/A	1,000 (51%)
North of Route 58 Bypass, Suffolk	19,820 (51%)	22,200 (48%)
Total Toll Transactions	67,440 (53%)	68,400 (51%)

Table 2-6b. Year 2026 Average Daily Traffic and Percent Diverted, 'Medium' Tolls

Toll Plaza Location	CBA 1	CBA 3
South of I-295	11,680 (67%)	N/A
Southbound on ramps and northbound off ramps at SR 156	1,180 (66%)	N/A
Between Route 156 and Disputanta	N/A	9,700 (68%)
North of Route 604, Wakefield	9,010 (71%)	10,200 (68%)
North of Route 258, Windsor	9,540 (71%)	10,400 (69%)
Northbound on-ramp and southbound off-ramp at Route 460	N/A	700 (65%)
North of Route 58 Bypass, Suffolk	13,190 (67%)	14,900 (65%)
Total Toll Transactions	44,600 (69%)	45,900 (67%)

Table 2-6c. Year 2026 Average Daily Traffic and Percent Diverted, 'High' Tolls

Toll Plaza Location	CBA 1	CBA 3
South of I-295	7,350 (80%)	N/A
Southbound on ramps and northbound off ramps at SR 156	710 (80%)	N/A
Between Route 156 and Disputanta	N/A	6,000 (81%)
North of Route 604, Wakefield	5,350 (82%)	6,200 (81%)
North of Route 258, Windsor	5,800 (82%)	6,400 (81%)
Northbound on-ramp and southbound off-ramp at Route 460	N/A	500 (79%)
North of Route 58 Bypass, Suffolk	8,600 (79%)	10,200 (76%)
Total Toll Transactions	27,810 (80%)	29,200 (79%)

The traffic diversion was also estimated to differ by travel market, as shown in **Table 2-7**. Light truck (2XT) trips were estimated to be the least likely to divert, and non-work (NW and LS) and heavy truck (5+XT) traffic the most likely.

Table 2-7. Estimated Diversion Fractions by Travel Market

Travel Market	Estimated Fraction of Traffic Diverted from Tolled Locations					
	CBA 1			CBA 3		
	'Low' Tolls	'Medium' Tolls	'High' Tolls	'Low' Tolls	'Medium' Tolls	'High' Tolls
Work-Related (WR)	38.0%	54.2%	68.5%	37.6%	52.4%	66.3%
Non-Work (NW)	64.3%	80.9%	90.5%	66.5%	88.1%	88.9%
Leisure (LS)	62.4%	84.2%	95.1%	66.5%	88.1%	97.3%
Two-axle truck (2XT)	26.4%	39.6%	55.2%	28.7%	42.0%	57.5%
Three- and four-axle Truck (34XT)	36.4%	52.3%	68.7%	41.8%	52.4%	65.0%
Five-axle (or more) Truck (5+XT)	60.6%	75.4%	85.9%	60.6%	75.8%	86.2%

2.5 TOLL PLAZA REVENUE ESTIMATES

Average daily revenues for the toll alternatives were estimated as the product of daily traffic times the average toll paid for each travel market. Average tolls were based on the observed composition of traffic on Route 460 within each travel market: 1.978 axles for the WR, NW, and LS markets (including motorcycles); 2.0 axles for 2XT; 3.647 axles for 34XT; and 5.017 axles for 5+XT. The estimated average daily revenues are shown in **Table 2-8**. The Smart Tag discount program would reduce the value of revenues by 4 to 14 percent, depending on the toll level and the number of vehicle axles.

Table 2-8. Estimated Year 2026 Average Daily Revenues (Thousands of Year 2004 Dollars)

Toll Plaza Location	CBA 1			CBA 3		
Toll Schedule ->	Low	Medium	High	Low	Medium	High
South of I-295	$36.3	$43.2	$52.3	$0.0	$0.0	$0.0
SB on ramps and NB off ramps at SR 156	$2.4	$3.3	$3.7	$0.0	$0.0	$0.0
Between Route 156 and Disputanta	$0.0	$0.0	$0.0	$29.1	$32.6	$41.7
North of Route 604, Wakefield	$36.7	$48.5	$50.5	$36.4	$48.9	$54.4
North of Route 258, Windsor	$38.9	$46.3	$44.3	$41.1	$54.4	$50.9
NB on-ramp and SB off-ramp at Route 460	$0.0	$0.0	$0.0	$0.0	$0.0	$0.9
North of Route 58 Bypass, Suffolk	$21.3	$42.7	$50.3	$23.4	$50.5	$58.5
TOTAL	**$135.6**	**$184.0**	**$201.1**	**$133.1**	**$186.4**	**$206.5**

3.0 FINANCIAL ANALYSIS

In the absence of firm construction cost estimates for the CBAs at the time this Summary Report was prepared, Parsons has estimated the net present value (NPV) of toll system net revenues that could be applied to offset those construction costs. This value was estimated by subtracting the estimated capital costs of the toll-related portion of each alternative from the NPV of toll net revenues for forty years of operation.

3.1 TOLL SYSTEM CAPITAL COSTS

The toll infrastructure costs of the CBAs were estimated at a conceptual level as shown in **Table 3-1**. These costs would be a small fraction of the total construction costs for either of the CBAs.

Table 3-1. Estimated Capital Costs of Toll Alternatives

Item	Unit Cost	CBA 3 'High' Tolls and CBA 1 (All Tolls)		CBA 3 'Low' and 'Medium' Tolls	
		Quantity	Cost	Quantity	Cost
Mainline Toll Plaza	$1,750,000	4	$7,000,000	4	$7,000,000
Ramp Toll Plaza	$560,000	2	$1,120,000	1	$560,000
Control and Administration Center	$6,250,000	1	$6,250,000	1	$6,250,000
TOTAL	N/A	N/A	$14,370,000	N/A	$13,810,000

3.2 TOLL SYSTEM OPERATING AND MAINTENANCE COSTS

The estimated operating and maintenance costs of the toll collection systems for CBAs 1 and 3 are shown in **Table 3-2** for the year 2026 for each of the toll schedules. The estimated *operating costs* represent the sum of three components:

1. The direct costs for toll collection, estimated in year 2004 dollars as:
   - $425,000 + $37,500 x number of tolled locations + $.09 x electronic transactions + $0.14 x other transactions.
   - This relationship was derived from toll highway authority annual reports for the year 2002 and from the Federal Highway Administration's report *Highway Statistics 2002*.
2. Maintenance costs for the toll collection facilities, estimated at 6.6 percent of the capital costs, $911,000 or $950,000 per year for the system. These costs include the annualized replacement costs of the high-technology toll collection system elements with life spans of ten years or less.

3. Toll authority overhead and administrative expenses, estimated as 25 percent of the total of the operating and maintenance costs described above. This represents either a very efficient stand-alone operation or integration into a larger toll authority where economies of scale would be expected.

The ongoing annual *maintenance costs* for the highway were estimated at $125,000 per route-mile per year, including overhead and administrative expenses. For both alternatives, the corresponding annual amount would be $6,525,000. Examination of year 2002 expenditures for 25 selected U.S. toll highways from the FHWA's *Highway Statistics 2002* and the agency's web-only publication *Toll Facilities in the United States*[12] indicated that their median annual maintenance expenditure per route-mile was about $138,000. Taking into account the absence of major waterway crossings and the simple configuration of the CBAs, these expenditures might come to about $100,000 per route-mile for the CBAs, exclusive of administration and overhead.

Major *scheduled program maintenance* (such as reconstruction and rehabilitation) will ultimately require significant investments in specific years. For many toll highways, these activities are financed from a reserve fund accumulated out of annual toll receipts. Because the traditional practice is to fund the activities with available funds, Parsons assumed these contributions would be made to this fund from the opening date of the toll system. These contributions were assumed to be one-half of the total of the sum of the operations and annual maintenance; this level is the estimated modal, or most commonly occurring, value for the 25 'peer' toll roads. A more accurate estimate would require engineering analysis of a detailed construction cost estimate, which was outside the scope of this study.

The estimated number of transactions for 2026 was assumed as a base, with growth extrapolated at 1.615 percent per annum. This rate represents the average growth rate between existing conditions (2003) and 2026 as estimated by the Location Study for the existing Route 460 at the proposed tolled locations.

3.3 TOLL SYSTEM NET REVENUE

The toll alternatives were estimated to yield net revenues for the year 2026 as shown in **Table 3-3**. Net revenues are the remainder once the operating and maintenance costs have been subtracted from the system gross revenues. The gross revenues shown are 365 times the average daily revenues from Table 2-8. Operating and maintenance costs decrease slightly for the higher toll levels because the number of transactions handled decreases substantially.

[12] FHWA Office of Highway Policy Information, FHWA-PL-03-017, June 2003

Table 3-2. Estimated Toll System Operating, Maintenance, and Administrative Costs (Thousands of Year 2004 Dollars)

Operating Year	CBA 1			CBA 3		
Tolls ->	Low	Medium	High	Low	Medium	High
2010	$17,074	$15,669	$14,640	$17,017	$15,650	$14,733
2011	$17,141	$15,713	$14,667	$17,086	$15,697	$14,762
2012	$17,208	$15,758	$14,695	$17,157	$15,745	$14,792
2013	$17,277	$15,803	$14,724	$17,228	$15,794	$14,822
2014	$17,348	$15,849	$14,752	$17,301	$15,844	$14,852
2015	$17,419	$15,896	$14,782	$17,375	$15,894	$14,883
2016	$17,491	$15,944	$14,812	$17,450	$15,945	$14,915
2017	$17,565	$15,993	$14,842	$17,526	$15,997	$14,947
2018	$17,639	$16,042	$14,873	$17,604	$16,050	$14,979
2019	$17,715	$16,092	$14,904	$17,683	$16,104	$15,012
2020	$17,793	$16,143	$14,936	$17,763	$16,158	$15,046
2021	$17,871	$16,195	$14,968	$17,844	$16,214	$15,080
2022	$17,951	$16,248	$15,001	$17,927	$16,270	$15,114
2023	$18,032	$16,301	$15,034	$18,011	$16,328	$15,149
2024	$18,114	$16,355	$15,068	$18,096	$16,386	$15,185
2025	$18,197	$16,411	$15,102	$18,183	$16,445	$15,221
2026	$18,282	$16,467	$15,137	$18,271	$16,505	$15,258
2027	$18,369	$16,524	$15,173	$18,361	$16,566	$15,296
2028	$18,456	$16,582	$15,209	$18,452	$16,628	$15,334
2029	$18,546	$16,640	$15,245	$18,544	$16,691	$15,372
2030	$18,636	$16,700	$15,283	$18,638	$16,755	$15,412
2031	$18,728	$16,761	$15,321	$18,734	$16,820	$15,452
2032	$18,822	$16,823	$15,359	$18,831	$16,887	$15,492
2033	$18,917	$16,886	$15,398	$18,929	$16,954	$15,534
2034	$19,013	$16,949	$15,438	$19,030	$17,022	$15,576
2035	$19,111	$17,014	$15,478	$19,131	$17,091	$15,618
2036	$19,211	$17,080	$15,519	$19,235	$17,162	$15,661
2037	$19,312	$17,147	$15,561	$19,340	$17,234	$15,705
2038	$19,415	$17,215	$15,603	$19,447	$17,307	$15,750
2039	$19,520	$17,284	$15,647	$19,556	$17,381	$15,796
2040	$19,626	$17,354	$15,690	$19,666	$17,456	$15,842
2041	$19,734	$17,425	$15,735	$19,778	$17,532	$15,889
2042	$19,844	$17,498	$15,780	$19,892	$17,610	$15,936
2043	$19,956	$17,572	$15,826	$20,008	$17,689	$15,985
2044	$20,069	$17,646	$15,872	$20,125	$17,769	$16,034
2045	$20,184	$17,722	$15,920	$20,245	$17,850	$16,084
2046	$20,301	$17,800	$15,968	$20,366	$17,933	$16,135
2047	$20,420	$17,878	$16,017	$20,490	$18,017	$16,186
2048	$20,541	$17,958	$16,067	$20,615	$18,103	$16,239
2049	$20,664	$18,039	$16,117	$20,743	$18,190	$16,292

Table 3-3. Estimated Year 2026 Net Revenues in Thousands of Year 2004 Dollars

Toll Schedule ->	CBA 1			CBA 3		
	Low	Medium	High	Low	Medium	High
Gross Revenues	$49,493	$67,143	$73,408	$47,830	$68,031	$75,382
Operating and Maintenance Costs	$18,282	$16,467	$15,137	$18,271	$16,505	$15,248
Net Revenues	$31,211	$50,676	$58,271	$29,559	$51,526	$60,124

Tables 3-4 and **3-5** show the estimated Route 460 toll system net revenues for each alternative and toll schedule by operating year for a 40-year period beginning in an assumed opening year of 2010. The forty-year bond period is about the longest that could reasonably be assumed; highway toll revenue bonds terms have typically ranged from 15 to 40 years.

3.4 FINANCIAL ANALYSIS

The key consideration of a toll feasibility study is whether the net revenues from a tolled operation can make a significant contribution to financing the project. This is typically determined by comparing the net present value (NPV) of the net revenues to the construction cost, using a discount rate representing the opportunity cost of capital.

Various economic theories have been advanced to support discount rates ranging from zero to 10 percent. A narrower range encompasses both the historic guidance of the Bureau of Public Roads[13] (4 percent) and current norms advanced both by the FTA[14] and Federal Railroad Administration[15] (7 percent). The value adopted for the Toll Feasibility Study is the midpoint of this narrower range (*i.e.*, 5.5 percent). In the late 1990s, most state highway agencies using life cycle cost analysis adopted rates in the 4-6 percent range.

Table 3-6 presents the estimates of amounts that could be financed based on the forecast NPV of net revenues, less the capital cost of the toll system elements. The amount that could be potentially financed was estimated as 56.6 percent of the net present value of the expected net revenues; this represents the provision of a debt coverage ratio (DCR) of 1.75 on the amount issued, and a one percent underwriter's discount. A DCR value of 1.75 is fairly conservative; further detailed study on behalf of the financing parties might support a ratio as low as 1.50. In that case, amounts that could be financed would be about 17 percent higher than with a ratio of 1.75.

Both CBA 1 and CBA 3 appear to be able to finance significant fractions of their construction costs. However, even at the 'low' toll level assumed, about half the potential users of the new untolled Route 460 would be dissuaded from using the road because of the tolls. At the 'medium' and 'high' levels, the diversion would be about 2/3 and 4/5, respectively. At these higher toll levels, the remaining toll road motorists would have a noticeably different income distribution from users of a new untolled

[13] Highway Research Board, Special Report 92, *Evaluation of Mutually Exclusive Design Projects*, 1967.
[14] Federal Transit Administration, *Advancing Major Transit Investments Through Planning and Project Development*, January 2003, Chapter 9.
[15] Federal Railroad Administration, *High-Speed Ground Transportation for America*, September 1997.

Route 460. Combined non-commercial users of the untolled facility (travel markets NW and WR) were estimated to have an average household income of $66,430; the study area population at large (see Table 2-2), which includes people who do not own automobiles, has an average household income of $53,870. By comparison, the users of the 'low', 'medium' and 'high' toll facilities for CBA 3 were estimated to have an average household income of $80,810, $89,510 and $96,800, respectively.

Table 3-4. CBA 1 Estimated Net Revenues by Operating Year (Year 2004 Dollars)

Operating Year	Low Tolls	Medium Tolls	High Tolls
2010	$21,228,000	$36,292,000	$42,169,000
2011	$21,780,000	$37,087,000	$43,059,000
2012	$22,341,000	$37,895,000	$43,964,000
2013	$22,910,000	$38,716,000	$44,883,000
2014	$23,489,000	$39,550,000	$45,816,000
2015	$24,078,000	$40,398,000	$46,765,000
2016	$24,675,000	$41,259,000	$47,729,000
2017	$25,283,000	$42,134,000	$48,709,000
2018	$25,900,000	$43,024,000	$49,705,000
2019	$26,527,000	$43,928,000	$50,716,000
2020	$27,165,000	$44,846,000	$51,744,000
2021	$27,812,000	$45,779,000	$52,789,000
2022	$28,470,000	$46,728,000	$53,851,000
2023	$29,139,000	$47,691,000	$54,929,000
2024	$29,819,000	$48,670,000	$56,025,000
2025	$30,509,000	$49,665,000	$57,139,000
2026	$31,211,000	$50,676,000	$58,271,000
2027	$31,924,000	$51,704,000	$59,421,000
2028	$32,648,000	$52,748,000	$60,589,000
2029	$33,385,000	$53,808,000	$61,777,000
2030	$34,133,000	$54,886,000	$62,983,000
2031	$34,893,000	$55,982,000	$64,210,000
2032	$35,665,000	$57,095,000	$65,455,000
2033	$36,450,000	$58,226,000	$66,721,000
2034	$37,248,000	$59,375,000	$68,008,000
2035	$38,058,000	$60,543,000	$69,315,000
2036	$38,882,000	$61,730,000	$70,644,000
2037	$39,719,000	$62,935,000	$71,993,000
2038	$40,569,000	$64,161,000	$73,365,000
2039	$41,433,000	$65,406,000	$74,759,000
2040	$42,312,000	$66,671,000	$76,175,000
2041	$43,204,000	$67,957,000	$77,614,000
2042	$44,110,000	$69,263,000	$79,077,000
2043	$45,032,000	$70,591,000	$80,563,000
2044	$45,968,000	$71,940,000	$82,073,000
2045	$46,919,000	$73,311,000	$83,607,000
2046	$47,886,000	$74,704,000	$85,166,000
2047	$48,868,000	$76,119,000	$86,751,000
2048	$49,866,000	$77,557,000	$88,361,000
2049	$50,881,000	$79,019,000	$89,997,000

Table 3-5. CBA 3 Estimated Net Revenues by Operating Year (Year 2004 Dollars)

Operating Year	Low Tolls	Medium Tolls	High Tolls
2010	$19,998,000	$36,998,000	$43,603,000
2011	$20,527,000	$37,801,000	$44,517,000
2012	$21,064,000	$38,617,000	$45,445,000
2013	$21,610,000	$39,446,000	$46,387,000
2014	$22,164,000	$40,289,000	$47,345,000
2015	$22,727,000	$41,145,000	$48,319,000
2016	$23,300,000	$42,015,000	$49,308,000
2017	$23,882,000	$42,899,000	$50,314,000
2018	$24,473,000	$43,797,000	$51,335,000
2019	$25,074,000	$44,710,000	$52,373,000
2020	$25,684,000	$45,638,000	$53,428,000
2021	$26,304,000	$46,580,000	$54,500,000
2022	$26,935,000	$47,538,000	$55,589,000
2023	$27,575,000	$48,511,000	$56,695,000
2024	$28,226,000	$49,500,000	$57,820,000
2025	$28,887,000	$50,505,000	$58,963,000
2026	$29,559,000	$51,526,000	$60,124,000
2027	$30,242,000	$52,564,000	$61,304,000
2028	$30,936,000	$53,618,000	$62,503,000
2029	$31,641,000	$54,690,000	$63,721,000
2030	$32,358,000	$55,778,000	$64,959,000
2031	$33,086,000	$56,885,000	$66,217,000
2032	$33,826,000	$58,009,000	$67,496,000
2033	$34,577,000	$59,151,000	$68,795,000
2034	$35,341,000	$60,312,000	$70,115,000
2035	$36,118,000	$61,492,000	$71,456,000
2036	$36,906,000	$62,690,000	$72,819,000
2037	$37,708,000	$63,908,000	$74,204,000
2038	$38,522,000	$65,146,000	$75,611,000
2039	$39,350,000	$66,403,000	$77,041,000
2040	$40,191,000	$67,681,000	$78,494,000
2041	$41,046,000	$68,980,000	$79,971,000
2042	$41,914,000	$70,299,000	$81,472,000
2043	$42,796,000	$71,640,000	$82,996,000
2044	$43,693,000	$73,003,000	$84,546,000
2045	$44,604,000	$74,387,000	$86,120,000
2046	$45,530,000	$75,794,000	$87,720,000
2047	$46,471,000	$77,223,000	$89,345,000
2048	$47,427,000	$78,676,000	$90,997,000
2049	$48,398,000	$80,152,000	$92,676,000

Table 3-6. Net Present Value of System Net Revenues at 5.5 Percent, 2010 – 2049

	CBA 1	CBA 3
'High' Toll Schedules		
NPV of Net Revenues in 2008 (for Comparison with Construction Estimate)	$847,966,000	$875,157,000
Estimated Amount Potentially Financed by Toll Revenue Bonds ($2004 in 2008)[16]	$465,337,000	$480,719,000
'Medium' Toll Schedules		
NPV of Net Revenues in 2008 (for Comparison with Construction Estimate)	$736,543,000	$749,130,000
Estimated Amount Potentially Financed by Toll Revenue Bonds ($2004 in 2008)	$402,863,000	$409,983,000
'Low' Toll Schedules		
NPV of Net Revenues in 2008 (for Comparison with Construction Estimate)	$450,955,000	$426,840,000
Estimated Amount Potentially Financed by Toll Revenue Bonds ($2004 in 2008)	$241,302,000	$227,659,000

[16] 57.14 percent of the NPV of Net Revenues in 2008, less one percent underwriter's discount, less capital costs from Table 3-1.

4.0 COORDINATION AND COMPARISON WITH OTHER TOLL STUDIES

Parsons' scope included a coordination effort with other ongoing toll studies to "determine whether there are common values (mean value of traveler time, operations and maintenance costs, assumed toll levels, etc) that should be considered between the studies and whether there are opportunities to meaningfully calibrate/compare results between studies". The most important comparison that could be made is among the values of travel time assumed. **Table 4-1** summarizes the information collected from two other studies in the area, and the values proposed for the Route 460 Toll Feasibility Study. The other studies are the Location Study itself (which did not model tolls on the proposed Route 460 improvements) and the HRPDC's Hampton Roads Toll Feasibility Study (HRTFS), which considered the Route 460 improvements as one of a number of corridors that might be tolled.

Because it is a part of the overall Route 460 Location Study, the Toll Feasibility Study's assumptions were based on common values where appropriate. One change proposed for the toll feasibility work was to disaggregate the WR and NW vehicle trips into four groups corresponding to income quartiles. Parsons set the quartile values (Q1 through Q4) as shown in Table 4-1. The corresponding Location Study values lie between quartiles 2 and 3, as would be expected. They are actually closer to quartile 3, because a significant fraction of the population in quartile 1 does not have access to an automobile, and Q1 is therefore underrepresented in highway traffic. The value for the Hampton Roads Toll Feasibility Study's LS travel market was set to equal the HRTFS's value for home-based other trips, and the values for single-unit commercial vehicles were similar to the HRPDC's values for external-to-external trips. For all three studies, values of time for NW travel were substantially lower than for WR travel (*i.e.* minutes per dollar were higher).

A comparison of forecast results could only be made with the HRTFS for the Route 460 corridor. For the year 2026, this study[17] indicated a decrease of average daily traffic on Route 460 from 37,500 to 15,050 for an end-to-end toll of $5.30. This represents a 59.9 percent diversion at a toll level about halfway between this study's 'low' and 'medium' levels, for which the estimated diversion rates were 52.7% for 'low' CBA 1 and 68.7% for 'medium' CBA 1, and 51.4% for 'low' CBA 3 and 67.4% for 'medium' CBA 3. As shown in **Figure 4-1**, comparison between the Toll Feasibility study projections suggests close agreement with the HRTFS.

The HRFTS preliminary financial analysis assumed that the Route 460 project construction would begin in 2010 and that toll revenues would begin to be collected in 2018. The Route 460 Toll Feasibility Study assumed a more aggressive schedule: construction starting in 2006, and completion in 2010.

The HRTFS assumed that operating and maintenance expenses would consume 30 percent of gross toll revenues. This is consistent with the results of this study, which indicated that the system operating and maintenance costs would consume between 22 and 24 percent of gross revenues for the 'medium' toll schedule in 2026 (close to Virginia's present per-mile median) and between 37 and 38 percent for the 'low' toll level (near the lowest per-mile tolls presently

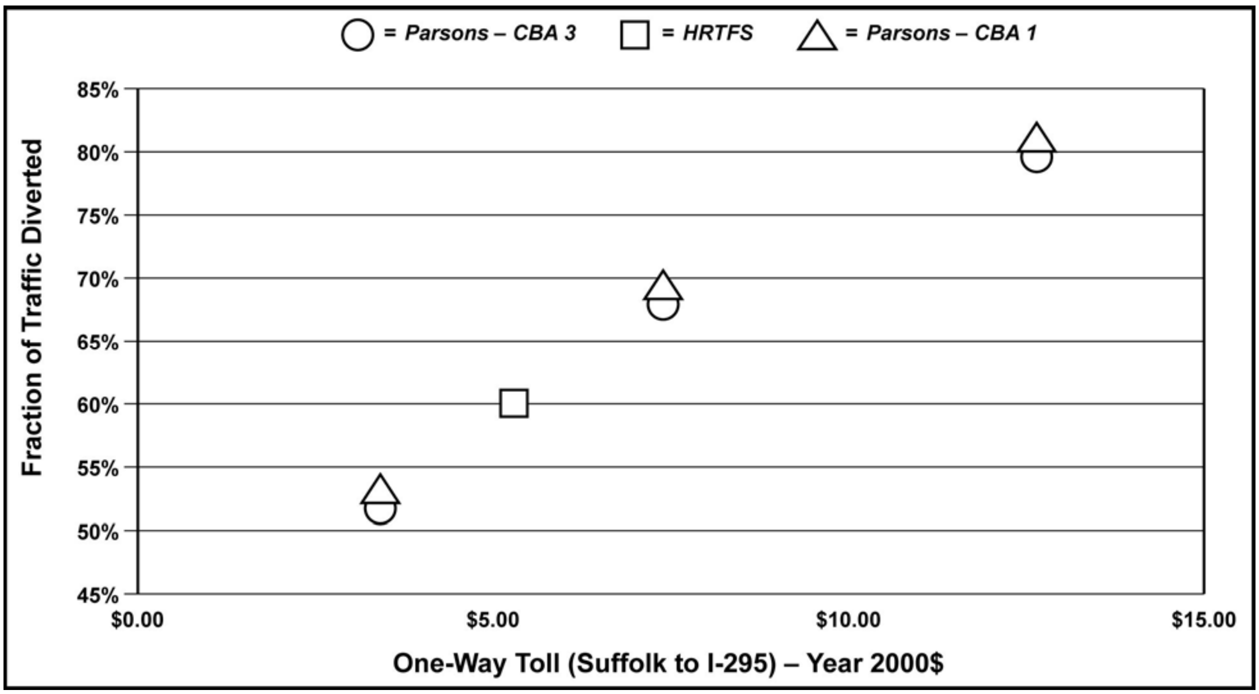
[17] Michael Baker, Jr., Inc., Hampton Roads Toll Feasibility Study, *Work-in-Progress Presentation*, September 15, 2004

charged in Virginia), depending on the operating year. The toll level assumed in the HRTFS was halfway between these levels. This suggests reasonable consistency between the HRTFS and this toll study.

Table 4-1. Comparison of Parameters for Toll Feasibility Study with Other Projects

Parameter	Hampton Roads Toll Feasibility Study	Route 460 Location Study[18]	Route 460 Toll Feasibility Study
Implicit Value of Travel Time for Home-based Work Trips (minutes/$)[19]	7.34	4.63	WRQ1 – 17.52 WRQ2 – 6.22 WRQ3 – 3.72 WRQ4 – 1.67
Implicit Value of Travel Time for Home-based Other Trips (minutes/$)	14.65	11.37	NWQ1 – 43.02 NWQ2 – 15.28 NWQ3 – 9.14 NWQ4 – 4.15 LS – 8.62
Implicit Value of Travel Time for Non-Home-based Trips (minutes/$)	N/A (3.67 for external-to-external trips)	9.48	2XT – 3.08 34XT – 2.40

Figure 4-1. Toll Sensitivity Comparison



[18] *Route 460 Location Study Travel Demand Model Validation Memorandum (Draft),* Michael Baker Jr., Inc., April 2004
[19] For other studies, values were converted to 2004 dollars using the Consumer Price Index